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Toxics Use Reduction Case Study

FOXBORO REDUCES VOC EMISSIONS WHILE ELIMINATING CADMIUM AND CYANIDE DISCHARGES

SUMMARY

The Foxboro Company, a manufacturer of industrial process controls located in southeastern Massachusetts, has engaged in a series of source reduction efforts since the late 1970s which have eliminated its discharge of cyanide, eliminated its use of cadmium and of ozone-depleting Freon, cut its emission of volatile organic compounds (VOCs) from painting operations by 99 %, and reduced its use of methylene chloride in degreasing operations. Company management views Toxics Use Reduction (TUR) as the most cost-effective means of meeting the challenges posed by increasingly stringent environmental regulations.

BACKGROUND

The Foxboro Company employs 3,500 people in three facilities in southeastern Massachusetts. The company manufactures instruments and automation systems for industrial process control. This involves a wide range of production processes, from electronic assembly to cleaning, plating, painting, degreasing and machining.

Foxboro has engaged in source reduction since the late 1970s in order to comply with increasingly stringent environmental regulations while protecting worker safety and the environment. The most notable success of these source reduction efforts was the retooling of painting operations to virtually eliminate emissions of VOCs -- chemical compounds which cause ground-level ozone, or smog. These reductions were achieved by switching from a solvent-based painting process to powder coating, and by changing product designs to do away with the need for painting certain products.

TOXICS USE REDUCTION PLANNING

Foxboro's history of successful source reduction encouraged the company to launch an ambitious Total Quality Environmental Management (TQEM) program in 1992. This program was conceived as a way to integrate the environmental commitments of top management into the corporate culture of the entire company.

The first step towards implementation of the TQEM program was a stratification analysis of all production processes, aimed at tracking the flow of key chemicals through the company's various production and treatment processes. With this analysis in place, the company was in a position to create TQEM teams to identify and implement process changes that would reduce or eliminate the company's use of materials

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deemed to be of greatest environmental concern -- such as Freon, cadmium, methylene chloride and waste paints.

Five TQEM teams were established in January 1992, and a sixth was created the following June. One team was charged with eliminating the use of chlorofluorocarbons (CFCs), such as Freon, which have been linked to the depletion of the stratospheric ozone layer and which must be phased out under the federal Clean Air Act. A second team was formed to find ways to reduce heavy metals in effluents. A third team was charged with making further reductions in VOC emissions, while a fourth team was assigned to eliminate the use of methylene chloride in degreasing operations. A fifth team was created to reduce miscellaneous chemicals generated by assembly operations, and a sixth was charged with creating a comprehensive new system for tracking all chemicals from purchasing through manufacturing to final disposition.

Each team met once a week for one hour during the time required for project planning and implementation. Each of these TQEM teams was supported by a senior operations manager and composed of five to seven people representing such departments as environmental management, production, engineering, purchasing, quality control, facilities and inventory control. The company's environmental manager served as technical consultant to all of the teams, and was a member of several of them. Teams also worked in close cooperation with a full-time quality consultant and with a corporate vice president who served as a link with the company's Quality Council.

TOXICS USE REDUCTION MODIFICATIONS

CFC TEAM: The CFC team identified, tested, and helped to implement CFC-free cleaning processes. Wherever possible, this was done by switching to no-clean solder fluxes, which entirely eliminates the need for cleaning. In some applications, no-clean fluxes are ruled out by specific customer requirements. The team accommodated these cases by purchasing new equipment for semi-aqueous cleaning. These changes required extensive worker retraining and a capital investment of about $500,000. This two-pronged approach virtually eliminated CFC use in all manufacturing operations by October 15, 1993 -- the date on which it became necessary, under the federal Clean Air Act, to attach special labels to products manufactured with ozone-depleting substances. In 1991, Foxboro purchased 6,000 gallons of Freon and emitted 23 tons to the air; by 1994, Freon use was eliminated entirely.

HEAVY METALS TEAM: The heavy metals team focused its attention primarily on eliminating the use of cadmium in the company's plating operations. This was done by eliminating unnecessary plating, and by switching from CdCN (Cadmium Cyanide) to ZnCo (Zinc Cobalt) for parts which do require plating. The change did not require any new plating equipment, and the vendor of the new plating bath provided technical support and worker retraining to facilitate the switch. The new plating formula has had no adverse effects on quality. The switch not only eliminated the health and safety problems associated with cyanide, it also permitted Foxboro to eliminate an entire process from its waste treatment operations.

PAINT TEAM: By 1990, Foxboro had already reduced its VOC emissions by 99 %, from 140 to 1.4 tons per year. The paint team investigated further VOC reduction opportunities, and investigated ways of reducing waste paint, which must be disposed of as a hazardous waste. By training workers in more efficient spraying techniques, cutting back on touch-up painting, and purchasing more efficient spray guns, the team cut VOC emissions by nearly 50 %, to 0.78 tons in 1993. Waste paints were also reduced, largely by isolating wet spraying from powder coating, thus eliminating the incorporation of nonhazardous powder coating wastes into hazardous wet paint wastes. Foxboro calculates that these steps have led to savings of about $5,000 per year in paint purchase and disposal costs.

METHYLENE CHLORIDE TEAM: The fourth team reduced the use of methylene chloride in degreasing operations by implementing alternative cleaning methods for a variety of steel and aluminum parts. Traditionally, Foxboro degreased all of its metal parts after machining. The idea was to remove coolants and cutting oils in order to insure better adhesion of paints and plating compounds. After a careful

evaluation of the soiling created by various machine shop operations, the methylene chloride team discovered that 2,200 parts did not require degreasing at all in order to meet established in-house cleanliness standards. Further reductions were achieved by introducing water-soluble coolants in machining operations and by using aqueous-based detergents to clean machined parts. As a result of the team's efforts, methylene chloride emissions were cut by more than 30 % between 1991 and 1994. A new team has been formed to take this project to the next step, expanding the use of aqueous cleaners and eliminating the use of methylene chloride entirely.

MISCELLANEOUS CHEMICALS TEAM: A fifth team was charged with reducing miscellaneous chemicals generated by assembly operations. The team focused its attention particularly on outdated epoxy resins and left-over customer samples that must be disposed of as hazardous wastes, at considerable expense to the company. The team's aim was to revise purchasing policies so that chemicals are purchased only in the quantities needed, and samples supplied by vendors are returned to the vendors after in-house evaluations. These simple changes in purchasing procedures have led to savings of more than $10,000 per year.

TRACKING SYSTEM TEAM: The sixth and last team was assigned the task of creating a new system for tracking chemicals from purchasing through manufacturing and final disposition. At the team's recommendation, information about the purchase and use of all chemicals was incorporated into an existing computerized materials tracking system. This system has helped Foxboro to validate its environmental reporting data and to identify further opportunities for reducing its use of toxic chemicals and its emissions of toxic industrial byproducts.

RESULTS

Reductions Achieved: Since implementing TQEM in 1992, Foxboro has added to its previous successes by eliminating CFCs, cadmium and cyanide from its manufacturing operations and reducing its use of methylene chloride by more than 30 %. VOC emissions, which had already been reduced drastically, were cut again by almost one half.

Economics: Foxboro calculates that its Toxics Use Reduction efforts have resulted in a cost savings of nearly $900,000 since 1993. Freon elimination accounted for the bulk of the savings. Cadmium reductions led to $35,000 in annual savings, while reductions in methylene chloride shaved annual costs by a further $56,000.

Foxboro's conversion to no-clean solder fluxes required a $500,000 capital investment in new equipment. This investment made it possible to eliminate Freon use, thus paying for itself in less than eight months.

After years of hands-on experience, company officials are convinced that source reduction is the most cost-effective means of meeting the challenges posed by increasingly stringent environmental regulations. This is not just because source reduction lowers tangible costs arising from chemical purchase and disposal, waste treatment, and licensing and laboratory fees; it is also because of the less direct and tangible benefits of source reduction which can be traced to improved employee safety and enhanced relations with community members and customers.

Figure 1: VOC Emission Reductions:

EMISSIONS IN TONS/YEAR

Chemical	1988	1989	1990	1991	1992	1993	1994
Methylene Chloride	27.0	11.2	25.4	28.7	21.7	18.6	19.8
Tetrachloroethylene	1.0	0.2	1.2	1.2	0	0	0
1,1,1 Trichloroethane	0.1	0.1	0.1	0	0	0	0
Trichloroethylene	2.6	0	0	0	0	0	0
Freon 113	17.4	15.2	16.4	23.0	6.4	8.7	0
Xylenes	3.9	1.6	1.5	1.4	1.0	0.8	0.7
TOTAL	**52.0**	**28.3**	**44.6**	**54.3**	**29.1**	**28.1**	**20.5**

TOTAL REDUCTION, 1988-1994: **61%**

Figure 2: Savings Due to **Acceleration** of Freon Phase-Out:

Year	1991	1992	1993	1994
Freon Cost (dollars/gallon)	$37.41	$50.45	$94.55	$136.46
Actual Usage (gallons)	5964	4199	1907	0
Projected Usage Without Acceleration (gallons)	5964	4199	4199	4199
Cost Difference (dollars)	-	-	**$216,709**	**$572,996**

TOTAL SAVINGS, 1993-1994: **$789,705**

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